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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/595,402

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Darrell H. Reneker

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04/24/2012

RENNER KENNER GREIVE BOBAK TAYLOR & WEBER
FIRST NATIONAL TOWER, SUITE 400
106 SOUTH MAIN STREET
AKRON, OH 44308-1412

EXAMINER

SYKES, ALTREV C

ART UNIT

PAPER NUMBER

1786

MAIL DATE

DELIVERY MODE

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/595,402	RENEKER ET AL.	
	Examiner	Art Unit	
	ALTREV SYKES	1786	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 January 2012.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 5) ☒ Claim(s) 1-4 and 6-34 is/are pending in the application.
- 5a) Of the above claim(s) 11-32 is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☒ Claim(s) 1-4, 6-10, 33 and 34 is/are rejected.
- 8) ☐ Claim(s) ____ is/are objected to.
- 9) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 12) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>20120125</u> . | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Response to Amendment

1. The amendment to the claims filed January 25, 2012 is acknowledged by examiner and has been entered. Claim 5 has been cancelled and claims 33 and 34 newly added. Claims 1-4 and 6-10 have been amended.

Response to Arguments

2. Applicant's arguments with respect to claims 1-4 and 6-10 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection. Specifically, the instant claims have been amended to recite that the nanotube extends from the first element fiber to a tip.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1, 4, 6, and 33 are rejected under 35 U.S.C. 102(e) as being anticipated by Knowles et al. (US 2004/0071870).

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5. Regarding claim 1, Knowles et al. discloses nanotubes may be attached to the tip portions of the micro-size or larger diameter fibers. (See Abstract and [0037]-[0038] wherein nanofibrils and whiskers are used interchangeably to describe single or multiwalled carbon nanotubes.) Knowles et al. discloses CVD can be used to grow carbon nanotubes 36 on the tips of carbon fibers 38. These deposition techniques utilize a nano-sized metal catalyst (e.g. nickel, or cobalt) particle on the carbon fiber 38 tip from which the carbon nanotube grows. (See [0089]) Knowles et al. discloses one method of depositing the catalyst particles on the ends of the carbon fibers 38, is by ion beam sputtering a thin film of catalyst metal onto the carbon fiber 38 tips, and then appropriate heat treatment and/or etching in order to create nanometer-sized catalyst particles. (See [0090]) Therefore, Knowles et al. anticipates a nanotube having at least one metal particle disposed thereon.
6. Regarding claim 4, Knowles et al. discloses the whiskers may comprise single or multiwalled carbon nanotubes. (See [0038])
7. Regarding claim 6, Knowles et al. discloses conventional carbon whiskers may be grown from a Ni catalyst. (See [0037])
8. Regarding claim 33, Knowles et al. discloses Figure 7A shows an array of nanofibrils (or nanotubes) 36 attached to the tip of a single fiber 38. (See [0072]) Knowles et al. discloses one method of depositing the catalyst particles on the ends of the carbon fibers 38, is by ion beam sputtering a thin film of catalyst metal onto the carbon fiber 38 tips,

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and then appropriate heat treatment and/or etching in order to create nanometer-sized catalyst particles. The nanofibril (or nanotube) 36 arrays then grow on the catalyst coated fibers 38 via PECVD processing. (See [0090]) As such, the prior art teaches that the metal catalyst is necessary in order to grow the nanofibril (or nanotube) 36. Therefore, one of ordinary skill in the art would appreciate that the at least one metal particle is present at the tip.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

11. Claims 2, 3, 10, and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Knowles et al. (US 2004/0071870).

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12. Regarding claims 2 and 3 Knowles et al. discloses the whiskers comprise single or multiwalled carbon nanotubes. Multiwalled nanotubes have larger diameters of up to about 500 nanometers. Knowles et al. also discloses that multiwalled nanotubes with diameters from 20-400 nm and lengths from 0.1-50 μm (or 100-50,000nm) are known in the art. (See [0040])

However, Knowles fails to specifically teach a nanotube having a diameter ranging from about 30 to about 300 nm and a nanotube having a length ranging from about 10 to about 10,000 nanometers. It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the diameter and length of the nanotube since it has been held that, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). The burden is upon the Applicant to demonstrate that the claimed diameter and length of the nanotube is critical and has unexpected results. In the present invention, one would have been motivated to optimize the diameter and length of the nanotube since such would have been well within the ordinary skill of one in the art as set forth in [0040] of Knowles above.

13. Regarding claim 10, Knowles et al. does not specifically disclose a third element nanotube extending from the second element nanotube at the location where the at least one metal particle is disposed. However, it would have been obvious to one of ordinary

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skill in the art at the time of the invention to arrive at the claimed invention since Knowles et al. discloses one method of depositing the catalyst particles on the ends of the carbon fibers 38, is by ion beam sputtering a thin film of catalyst metal onto the carbon fiber 38 tips, and then appropriate heat treatment and/or etching in order to create nanometer-sized catalyst particles. The nanofibril (or nanotube) 36 arrays then grow on the catalyst coated fibers 38 via PECVD processing. (See [0090]) As such, the prior art teaches that a metal catalyst is necessary in order to grow the nanofibril (or nanotube) 36. Therefore, one of ordinary skill in the art having the desire to grow more than one nanotube wherein the nanotubes are grown one from the other would appreciate that the first nanotube would need to comprise a metal particle. Motivation to coat the nanotube is found in Knowles. Knowles et al. discloses the nanotubes 36 can be coated. (See [0091]) Therefore, the claimed invention would have been obvious to one of ordinary skill in the art at the time of the invention.

14. Regarding claim 34, Knowles et al. discloses many configurations are possible depending on the application requirements. (See [0073]) Knowles et al. discloses the characteristics or attributes of the nanofibrils (or nanotubes) 36, for example diameter, length, packing fraction, location, etc. can vary wherein many of the characteristics can be controlled by the growth process. (See [0080]) Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to dispose at least one metal particle on a sidewall of the second element nanotube motivated by the desire to tailor the attributes and configuration of the nanotubes based on application requirements.

15. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Knowles et al. (US 2004/0071870) in view of Hou et al. *Carbon Nanotubes Formed on Carbonized Electrospun Polymer Nanofibers*. Polymer Preprints **2003**, 44(2), pgs. 63-64. (submitted by applicant)
16. Regarding claim 7 and 8, Knowles et al. discloses the micro-size or larger diameter fibers may be commercially available carbon fibers are formed from either pitch or PAN precursor material and drawn onto fiber tow. (See [0032] and [0074]) However, Knowles et al. does not specifically disclose that the fibers 38 are electrospun or carbonized.
17. Hou et al. discloses carbon nanotubes formed on carbonized electrospun polymer nanofiber. (See Title and Experimental Sections pg. 63) Hou et al. discloses PAN was selected as a suitable precursor for making electrospun nanofibers since it is well known route to carbon fibers. (See Results and Discussion, bottom of pg. 64) Hou et al. discloses the carbon nanotube on carbon nanofiber structure can be made into a fine sheet since the electrospun non-woven nanofiber sheet can be prepared very thin. Such structures are used in applications such as high-performance filters, reinforced composites, and highly porous carbon nano-electrodes. (See last paragraph of Results and Discussion Section, pg. 64) Hou et al. discloses in the carbonization treatment,

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thermoplastic PAN is converted to a non-plastic cyclic or ladder compounds. (See second paragraph of Results and Discussion pg. 64)

18. As Knowles et al. and Hou et al. are both directed to carbon nanotubes formed on a fiber, the art is analogous. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to replace the micro-size or larger diameter fibers 38 as disclosed by Knowles et al. with the carbonized electrospun nanofibers as taught by Hou et al. motivated by the desire to produce a fine sheet of the carbon nanotube on carbon nanofiber structure useable in applications such as high-performance filters, reinforced composites, and highly porous carbon nano-electrodes. (See last paragraph of Results and Discussion Section, pg. 64)
19. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Knowles et al. (US 2004/0071870) in view of Chen et al. (US 6,495,258).
20. Regarding claim 9, Knowles et al. discloses all of the claim limitations as set forth above, but the reference does not specifically disclose fiber 38 is boron nitride, boron carbide, nitrogen carbide or silicon.
21. Chen et al. discloses a composite having a three dimensional distribution of carbon nanotubes. (See Abstract) Chen et al. discloses structure-forming fibers in the composite provide mechanical integrity and strength to the article, i.e. provide an overall physical

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structure and framework to hold carbon nanotubes in place. (See Col 5, lines 10-13)

Chen et al. discloses a broad variety of fibers may be used including ceramic fibers and carbon fibers having diameters on the order of 0.5-50microns. (See Col 5, lines 30-42)

Chen et al. disclose the ceramic materials for the fibers include silica and boron nitride. (See Col 5, lines 55-60)

22. As Knowles et al. and Chen et al. are both directed to composite materials comprising carbon nanotubes and micro-size fibers, the art is analogous. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to substitute the ceramic fibers as taught by Chen et al. for the carbon fibers as disclosed by Knowles et al. motivated by expected success of providing an overall physical structure and framework to hold carbon nanotubes in place since Chen teaches that both ceramic and carbon fibers are suitable. (See Col 5, lines 10-13)
23. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Conclusion

24. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Knowles et al. (US 6,913,075) disclose nanofibrils may be attached to the tip portions of larger diameter fibers. (See Abstract) Hafner et al. (US 6,716,409) discloses SWNT probes fabricated using metallic colloids. (See Abstract)
25. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).
- A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.
26. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ALTREV SYKES whose telephone number is (571)270-

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3162. The examiner can normally be reached on Monday-Thursday, 8AM-5PM EST, alt Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Chriss can be reached on 571-272-7783. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Elizabeth M. Cole/
Primary Examiner, Art Unit 1798

/ACS/
Examiner
4/11/12